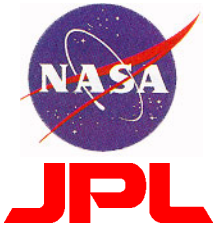

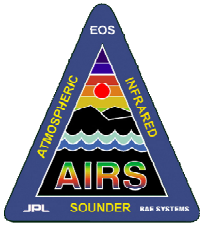

Using Collocated NCEP Quality-Controlled Radiosondes for AIRS Physical Retrieval Uncertainty Determination

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AIRS Science Team Meeting

Using Collocated NCEP Quality-Controlled Radiosondes for AIRS Physical Retrieval Uncertainty Determination

- **The AIRS Standard Product retrieved temperature and water vapor profiles will be compared to collocated NCEP quality-controlled radiosonde data to statistically determine the uncertainty of the physical retrieval as a function of (singly and in combination):**
  - **Atmospheric State (clear/cloudy)**
  - **Scan Angle**
  - **Latitude**
  - **Surface Type (ocean/land/mixed)**
  - **Diurnal Cycle (day/night or finer slice of solar zenith angle if required)**
  - **Season**
  - **Retrieval Type**
    (e.g., complete: retrieval_type=0; MW-only: retrieval_type=50)
- **The goal is to demonstrate that the retrieval uncertainties of the AIRS Standard Product meet or exceed the requirement of 1 K rms/Km for the temperature profile and 20% for the humidity profile in the troposphere.**

Process for T,q Uncertainty Determination

- **RaObs matchup PGE creates HDF swath L1B matchups of radiosondes and AMSU footprints from L1B AIRS Product and a truth index file derived from PREPQCH (HDF translation and extraction of subset of NCEP quality-controlled radiosonde data)**
- **L2 matchup PGE ingests the HDF swath L1B matchup product and performs L2 retrieval, creating HDF swath L1B+L2 product**
- **Tool implemented in IDL accepts date range and ingests one or more HDF swath L1B+L2 product files and the PREPQCH data files they reference**
  - **Invalid data are identified and so marked (individual levels or complete measurements if insufficient number of valid levels)**
  - **Matchups are arranged to collect all L1B+L2 data associated with each individual radiosonde into a single group**
  - **Data selection/filtering is applied to extract desired matchup population**
  - **T,q difference profiles (and their level-by-level variances) for each member of matchup population are computed at populated standard product levels using radiosonde data and one or more of the valid collocated retrievals (currently: average of all or nearest in time or nearest in distance)**
  - **Average T,q bias profiles and their level-by-level uncertainty are computed for desired matchup population**
  - **Statistics over total profile and portions of the troposphere are computed**

12/14/2000 Simulation Golden Day Processing and Selection Criteria

	PROCESSING
L1B PGE	V2.2.3.10
L2 PGE	V2.2.3.10
RaObs Matchup PGE	V2.2.3.22
	MATCHUP INCLUSION CRITERIA
Lat Range	ALL (but range can be selected)
Lon Range	ALL (but range can be selected)
Day/Night	ALL (but range can be selected)
Surface	ALL (but range can be selected)
Atmospheric State	No Restrictions on cloud fraction
Radiosonde Completeness	T N_Levels > 2 WV N_Levels > 2
	RETRIEVAL INCLUSION CRITERIA
Miss distance/time	$\Delta R < 100$ km and $\lvert\Delta T\rvert < 3$ hr (both can be restricted)
Scan Angle	ALL
Retrieval Type	0 (All retrieval stages acceptable)
Matchup Bias Calculation	Average of all retrieval biases matched to radiosonde

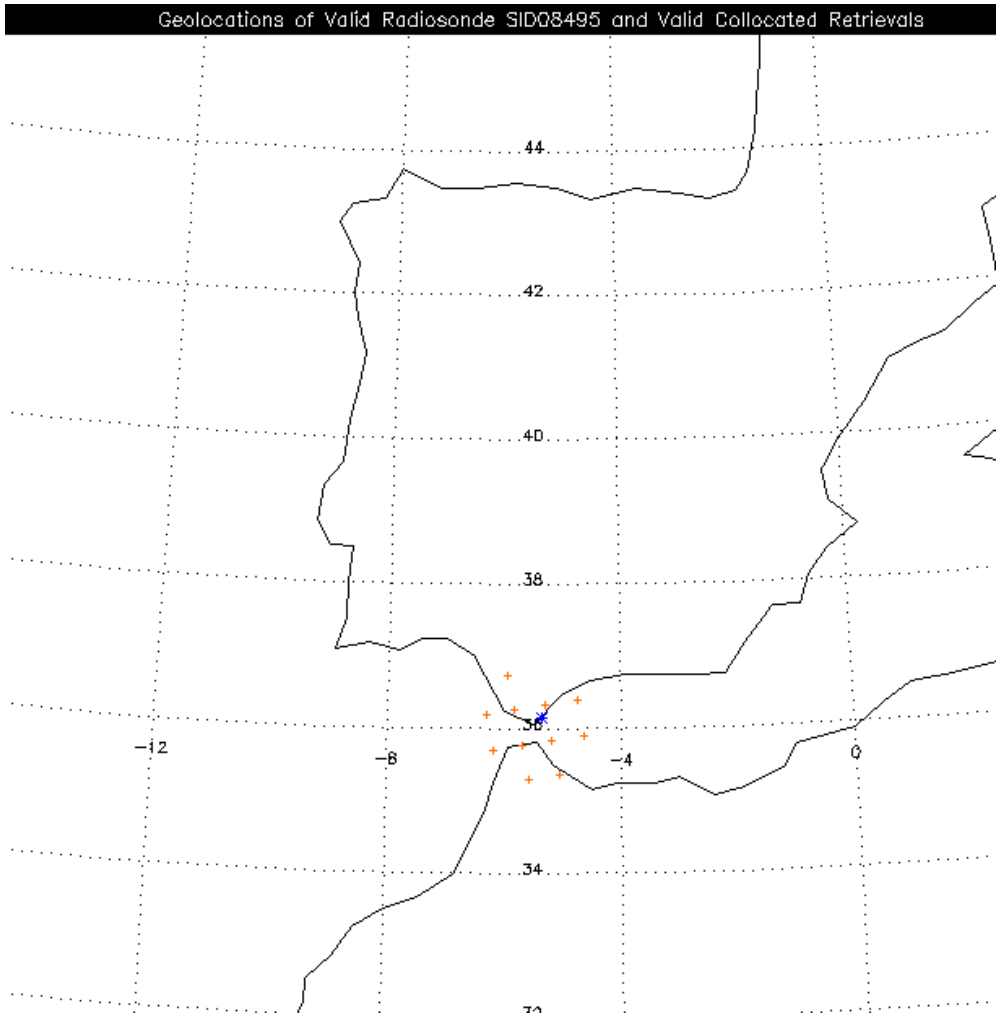
Geolocation of Example Collocation Group in 12/14/2000 Simulation Golden Day

Example contains 11 Collocated Retrievals (+) and associated radiosonde (*) which satisfy selection criteria

The profile difference for this group may be calculated

1. **by combining the profiles of all 11 collocated retrievals to create an average retrieval profile**
2. **by choosing the retrieval whose FOV is nearest to the location of the radiosonde**
3. **by choosing the retrieval whose time of observation is most coincident with that of the radiosonde**

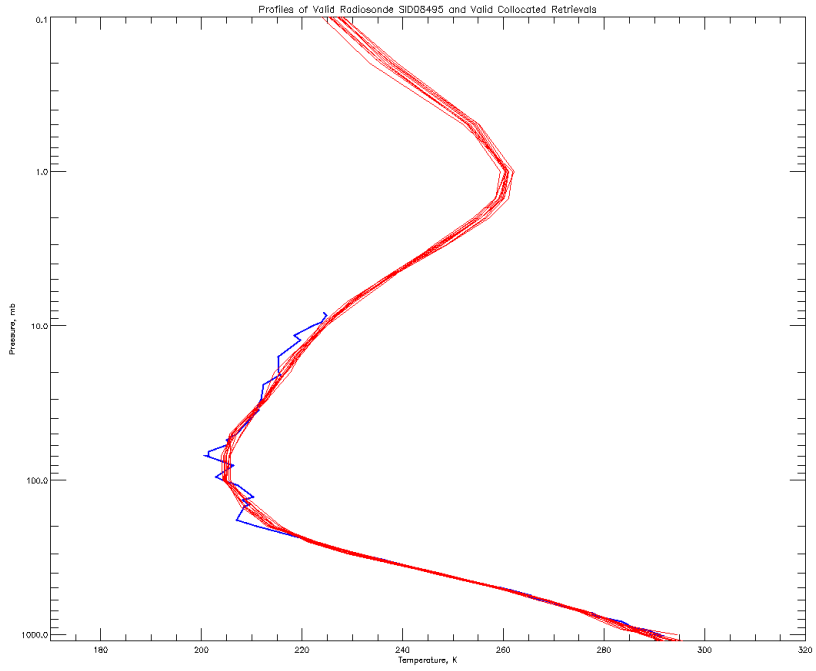
and subtracting the radiosonde profile level-by-level from the average or chosen retrieval profile

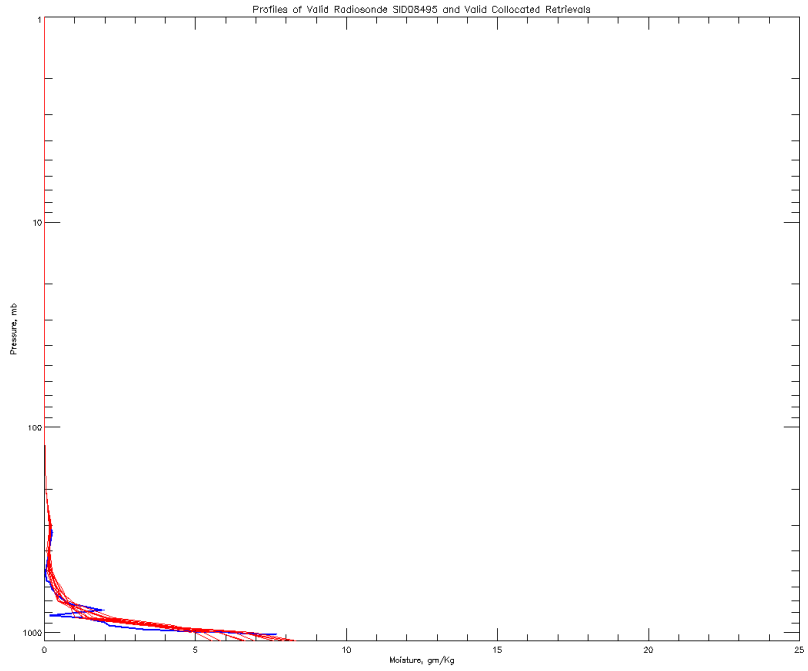


T,q Profiles for Example Collocation Group in 12/14/2000 Simulation Golden Day

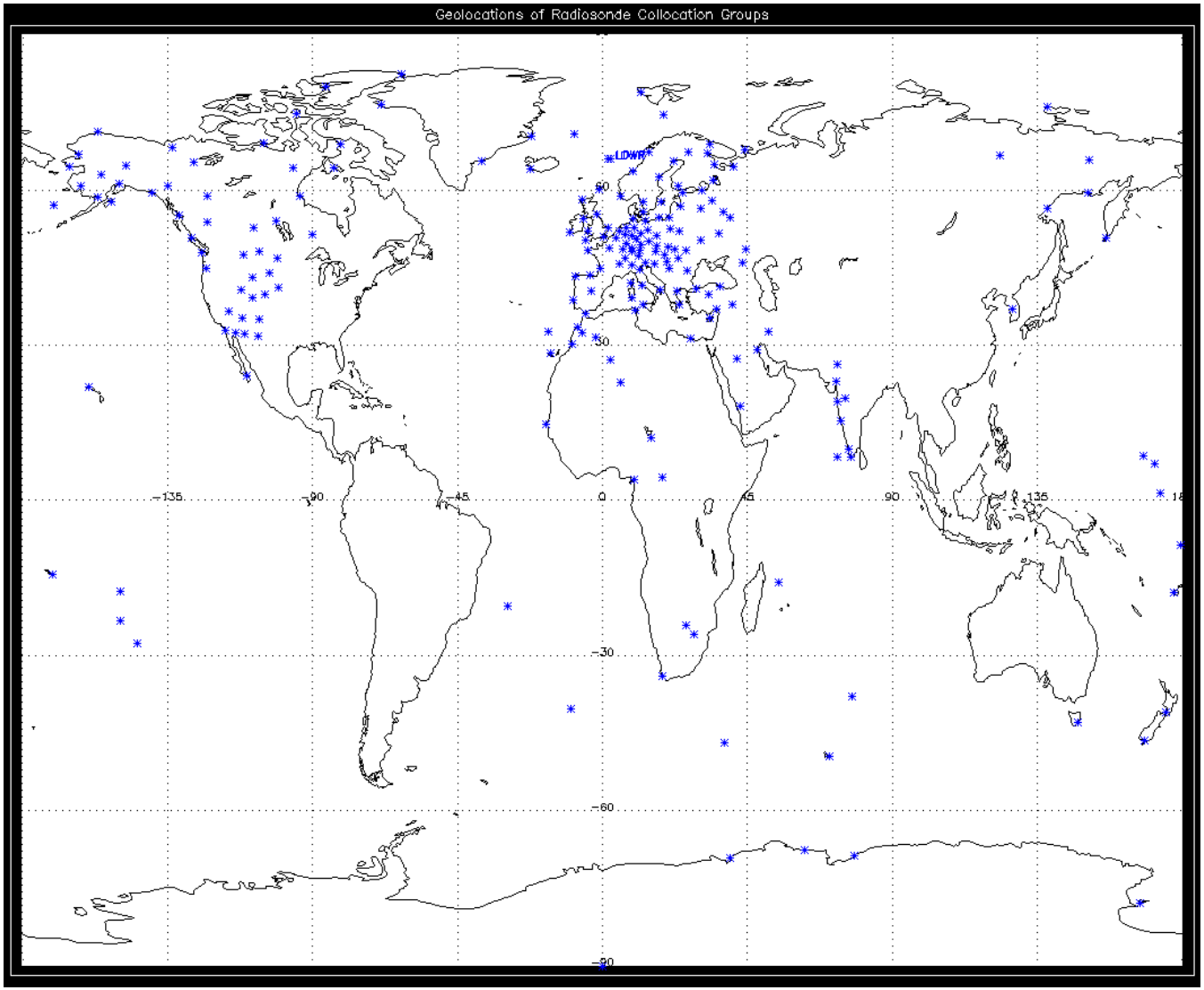
The temperature and water vapor profiles of the radiosonde and the 11 collocated retrievals

- **Retrievals capture spatial inhomogeneity near the surface, especially for moisture**
- **Retrievals do not capture the fine structure observed by the in-situ measurement**





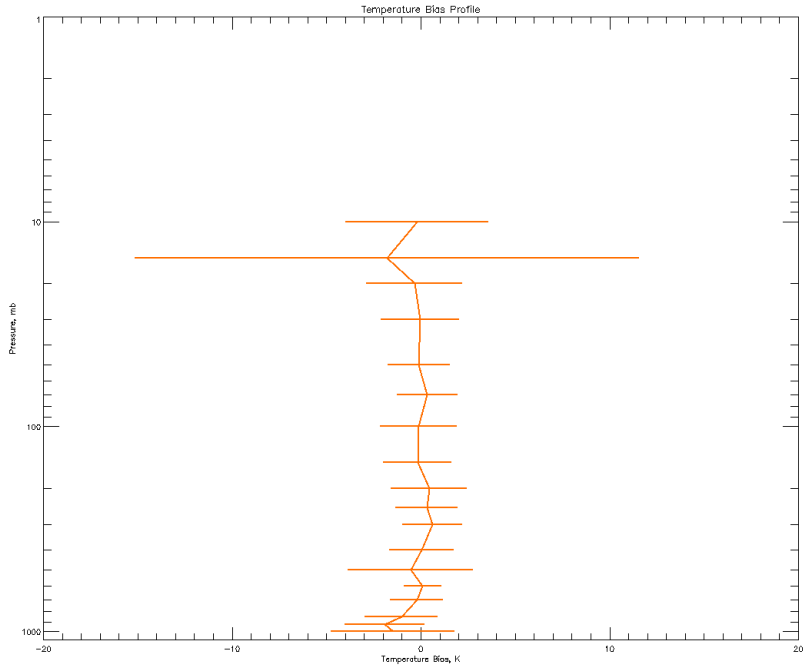
Geolocations of 355 Collocation Groups in 12/14/2000 Simulation Golden Day

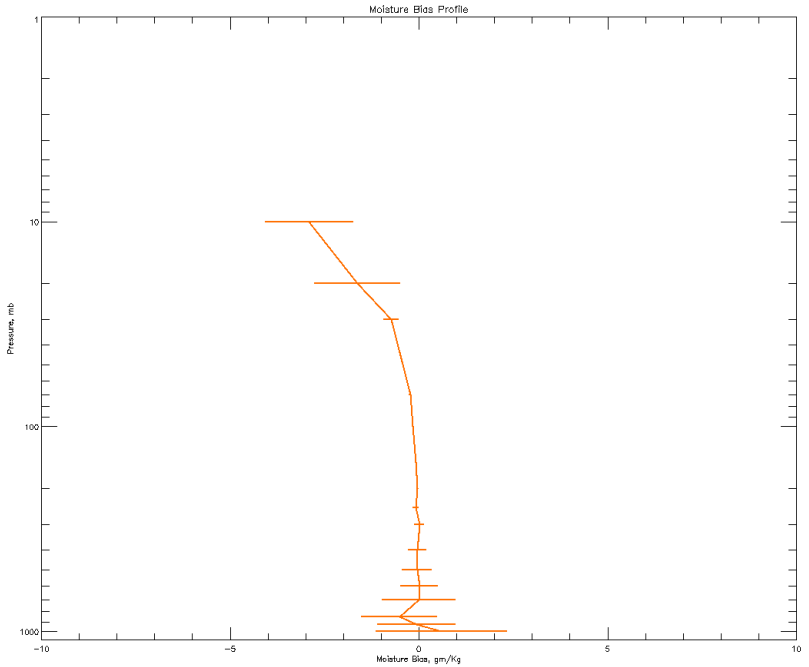


Global Average Bias Profiles of T,q for Selected Collocation Groups in 12/14/2000 Simulation Golden Day

The 242 surviving collocation group temperature and water vapor bias profiles have been averaged level-by-level to calculate a global average bias and standard deviation for each.

- **The individual collocation group biases were calculated by level-by-level averaging of all retrievals and subtracting the radiosonde profile.**
- **The levels do not have equal numbers of collocation groups, usually due to an invalid radiosonde measurement at that level. The RMS of a level with only one collocation group is set to zero.**





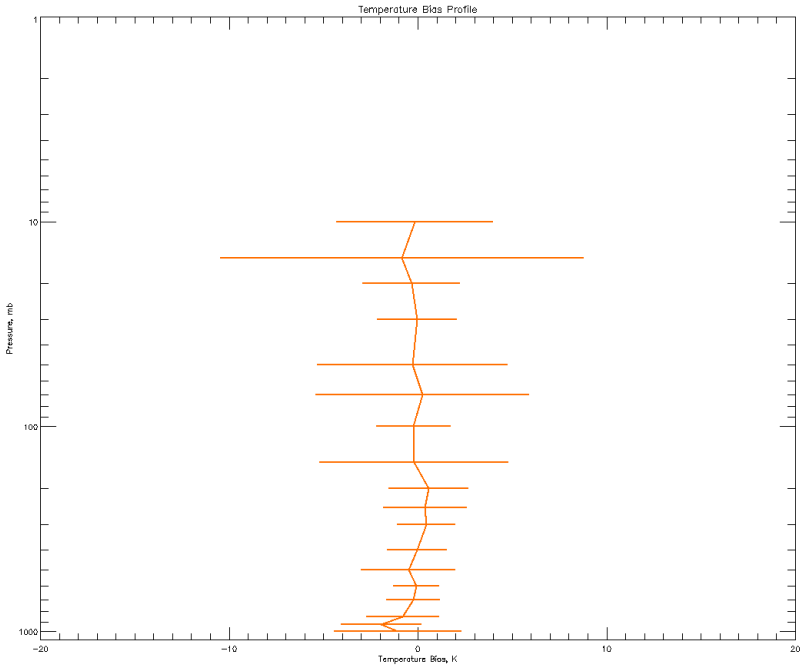
Global Statistics for 12/14/2000 Simulation Golden Day

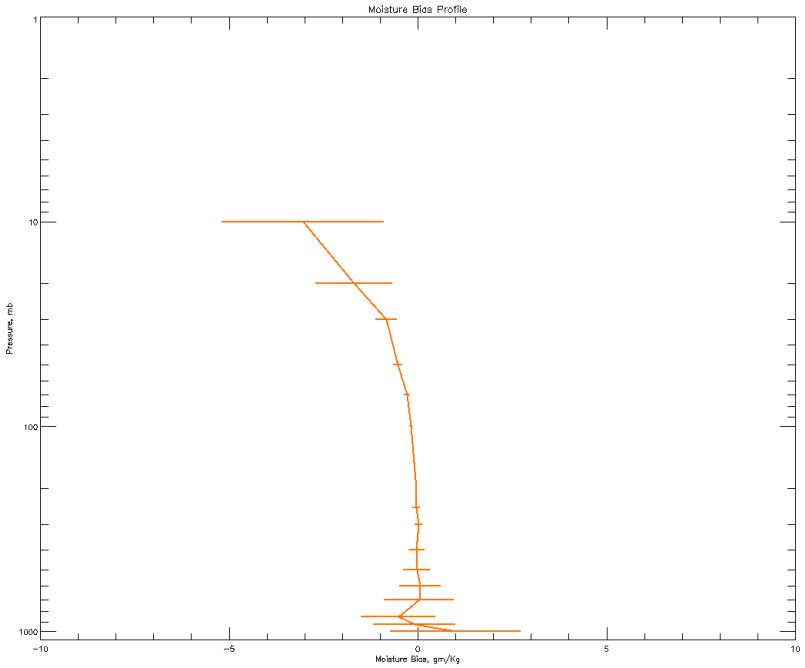
# Collocation Groups = 242 Total Sample = 355		TEMPERATURE PROFILE STATS				WATER VAPOR PROFILE STATS			
	Atmosphere Range	Avg Bias	STD	# Levels	Min, Max # sondes	Avg Bias	STD	# Levels	Min, Max # sondes
Stats Using Average of ALL Collocated Retrievals	Lower troposphere p>700 mb	-1.12	0.71	4	108 241	0.05	0.57	4	82 232
	Troposphere p>100 mb	-0.32	0.76	12	21 242	-0.02	0.32	11	3 232
	Total profile	-0.32	0.74	18	21 242	-0.38	0.87	15	3 232
Stats Using Nearest in TIME Collocated Retrieval	Lower troposphere p>700 mb	-1.18	0.74	4	90 241	0.07	0.63	4	65 232
	Troposphere p>100 mb	-0.33	0.80	12	21 242	-0.01	0.36	11	3 232
	Total profile	-0.32	0.76	18	21 242	-0.37	0.88	15	3 232
Stats Using Nearest in DISTANCE Collocated Retrieval	Lower troposphere p>700 mb	-1.27	0.78	4	87 241	0.02	0.49	4	61 232
	Troposphere p>100 mb	-0.36	0.85	12	21 242	-0.03	0.28	11	3 232
	Total profile	-0.34	0.81	18	21 242	-0.39	0.85	15	3 232

Global Average Bias Profiles of T,q for Selected Collocation Groups in 12/14->15/2000 Simulation Days

The 545 surviving collocation group temperature and water vapor bias profiles have been averaged level-by-level to calculate a global average bias and standard deviation (STD) for each.

- **The reduction in STD over the single Golden Day is not "SQRT(2)". This indicates that the model is smooth and the STD is being driven by some outliers. Selection criteria must be refined to remove the latter.**





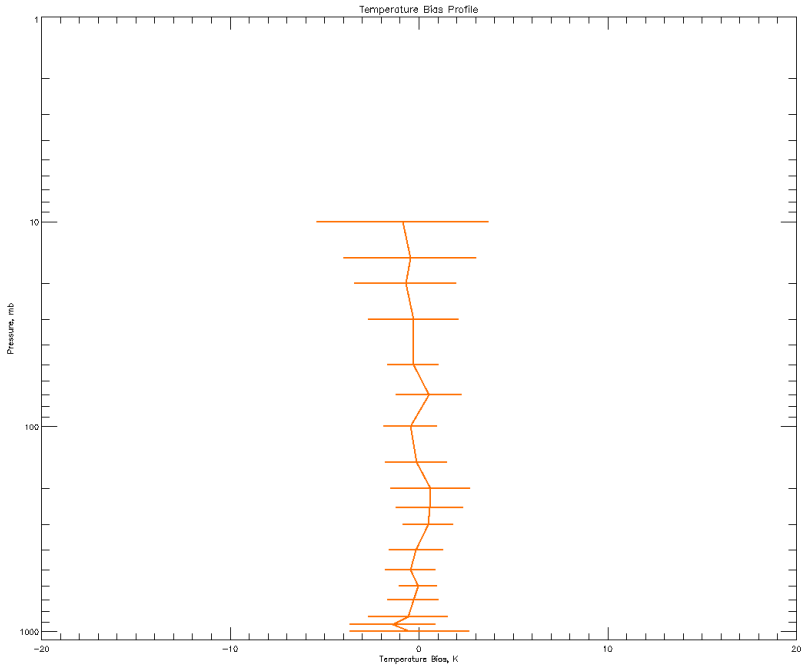
Global Statistics for Combined 12/14->15/2000 Simulation

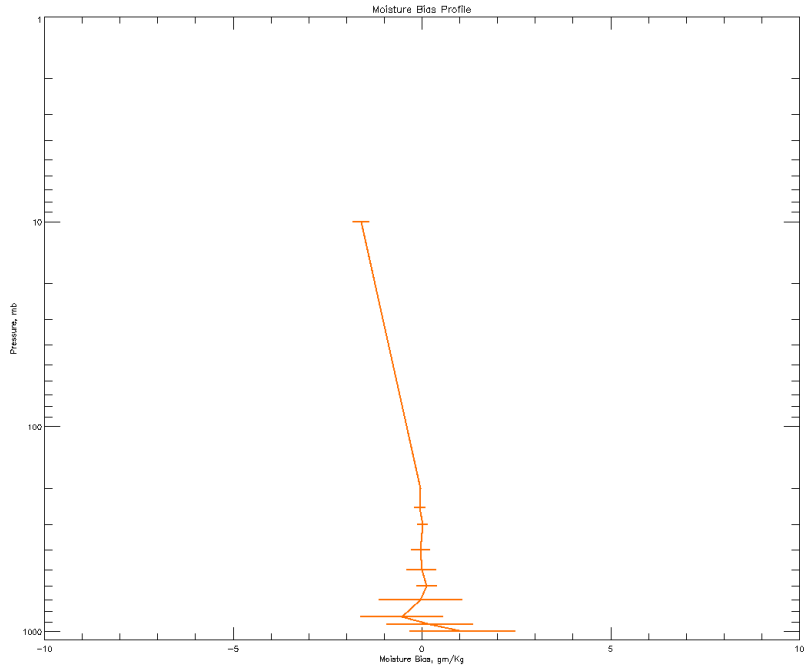
# Collocation Groups =545 Total Sample = 801		TEMPERATURE PROFILE STATS				WATER VAPOR PROFILE STATS			
	Atmosphere Range	Avg Bias	STD	# Levels	Min, Max # sondes	Avg Bias	STD	# Levels	Min, Max # sondes
Stats Using Average of ALL Collocated Retrievals	Lower troposphere p>700 mb	-1.01	0.70	4	243 542	0.11	0.64	4	198 522
	Troposphere p>100 mb	-0.31	0.70	12	43 545	0.01	0.35	12	7 522
	Total profile	-0.28	0.60	18	43 545	-0.37	0.87	17	3 522
Stats Using Nearest in TIME Collocated Retrieval	Lower troposphere p>700 mb	-1.04	0.74	4	206 541	0.15	0.68	4	163 521
	Troposphere p>100 mb	-0.31	0.73	12	43 545	0.02	0.37	12	7 521
	Total profile	-0.29	0.61	18	43 545	-0.36	0.88	17	3 521
Stats Using Nearest in DISTANCE Collocated Retrieval	Lower troposphere p>700 mb	-1.14	0.78	4	199 542	0.10	0.62	4	156 522
	Troposphere p>100 mb	-0.35	0.77	12	43 545	0.00	0.34	12	7 522
	Total profile	-0.31	0.66	18	43 545	-0.37	0.87	17	3 522

Global Average Bias Profiles of T,q for Night, Ocean Collocation Groups in 12/14->15/2000 Simulation Days

The 545 surviving collocation group temperature and water vapor bias profiles have been subjected to an additional filter that chooses only those that are at night and over the ocean.

- **118 collocation groups passed the Night, Ocean filter**
- **We obviously have greater success with this subset**
  - **The bias and the level-by-level STD of both profiles are significantly reduced**

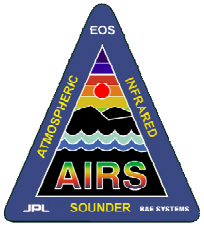




Night, Ocean Statistics for Combined 12/14->15/2000 Simulation

# Collocation Groups =118 Total Sample = 801		TEMPERATURE PROFILE STATS				WATER VAPOR PROFILE STATS			
	Atmosphere Range	Avg Bias	STD	# Levels	Min, Max # sondes	Avg Bias	STD	# Levels	Min, Max # sondes
Stats Using Average of ALL Collocated Retrievals	Lower troposphere p>700 mb	-0.69	0.48	4	96 118	0.18	0.67	4	77 113
	Troposphere p>100 mb	-0.19	0.57	12	12 118	0.09	0.43	9	5 113
	Total profile	-0.24	0.53	18	12 118	0.09	0.43	9	5 113
Stats Using Nearest in TIME Collocated Retrieval	Lower troposphere p>700 mb	-0.63	0.46	4	96 118	0.22	0.68	4	77 113
	Troposphere p>100 mb	-0.16	0.54	12	12 118	0.11	0.43	9	5 113
	Total profile	-0.21	0.51	18	12 118	0.11	0.43	9	5 113
Stats Using Nearest in DISTANCE Collocated Retrieval	Lower troposphere p>700 mb	-0.74	0.50	4	96 118	0.17	0.68	4	77 113
	Troposphere p>100 mb	-0.23	0.59	12	12 118	0.09	0.43	9	5 113
	Total profile	-0.26	0.55	18	12 118	0.09	0.43	9	5 113

Future Activity



- **Refine data selection/rejection algorithm so that outliers do not drive statistics, but do not willy-nilly throw away data which does not agree with preconceptions.**
- **Test the various clear FOV detection filters and employ appropriate filter(s) in combination with other selection criteria for analyses.**
- **Implement filtering of radiosonde launch sites to select most reliable.**
- **Implement trend analyses.**
- **Automate analyses as appropriate.**
- **See how the statistics of REAL ON-ORBIT DATA behave!**